

Waste Characterization Study

Final Report

July 8, 2019





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1. INTRODUCTION

1.1 OVERVIEW

The University of Kentucky, located in Lexington, is a large public state university that houses 17 academic and professional colleges. Included on the almost 1,000-acre campus are two hospitals, a Division I football stadium, dining facilities, residential housing for students and general campus buildings (classrooms, offices, laboratories).

The University reports that it generates approximately 10,000 tons of municipal solid waste (MSW) and diverts 3,000 tons of recyclable material per year. To date, the University has never performed a comprehensive waste characterization study. The University of Kentucky Recycling Program is interested in understanding its landfill waste stream including identifying the variability of the waste composition across the different generator types on campus and improving the capture of recyclables and compostables. The University retained MSW Consultants to perform a campus-wide waste composition study over the course of one week in October 2018. Findings from this study will be used to select new programs or to modify existing programs, and improve outreach related to campus disposal and recycling programs.

The purpose of this study was to characterize the University of Kentucky's solid waste stream destined for landfill. Study goals included:

- ◆ Representatively sample all points of generation from the University's waste stream.
- ◆ Quantify the weight and statistically analyze each material category for the aggregate MSW stream and for each generator sector.
- ◆ Analyze the waste composition variability between generator sectors.
- ◆ Identify the type and quantity of potentially recoverable recyclables and compostable material in the disposed waste stream.

1.2 REPORT ORGANIZATION

The remainder of this report presents the methodology and results of the 2018 Study. The report is divided into the following sections:

- ◆ **Methodology:** This section quantifies waste disposal quantities captured in the study, presents the sampling plan, and summarizes the field data collection methods and analytical methods applied in the study.
- ◆ **Results:** Detailed composition results of the University of Kentucky's disposed waste are presented in this section. Results are presented in both tabular and graphical format to highlight findings of interest.
- ◆ **Conclusions and Recommendations:** This section presents the conclusions and recommendations for further study.
- ◆ **Appendices:** Supplemental results tables and other study details are provided in the appendices.

1. INTRODUCTION

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2. METHODOLOGY

2.1 STUDY DESIGN

MSW Consultants conducted the waste composition study over the course of six days from October 1 through 6, 2018. The sort was conducted at the Bluegrass Transfer Station on Old Frankfort Pike in Lexington. The transfer station receives waste from the University's designated hauler, Central Kentucky Hauling, as well as the University's own disposal vehicles.

Prior to conducting the field work portion of the study, a sampling plan was developed with University staff to assure that the incoming truckloads of waste that were ultimately sampled and characterized were representative of the entire landfill waste stream generated by the University. Representative samples were allocated across the various generator sectors of the campus based on the annual tonnages and collection schedule provided by the University. The methodology is summarized below.

2.1.1 WASTE GENERATOR SECTORS

Generator sectors are comprised of unique waste collection routes/areas of campus or vehicle types. The following seven generator sectors were defined and surveyed during the waste composition study:

- ◆ **Front Loader Truck:** Includes waste collected daily, Monday through Friday, from a variety of on-campus locations such as student and office buildings, medical offices, athletic fields and laboratories. Per the information provided by the University there was no way to further subdivide the wastes collected via the front loader, with the exception of football stadium waste that was analyzed separately.
- ◆ **General Campus:** Includes waste primarily from classroom/office buildings, research buildings/laboratories, and medical offices.
- ◆ **Dorms:** Includes waste collected from residential student housing.
- ◆ **Dining:** Includes front- and back-of-house waste from on-campus cafeterias, restaurants, and cafes.
- ◆ **Football Stadium:** Includes front- and back-of-house waste from the football stadium, including food generating areas, as well as the tailgate areas surrounding the stadium.
- ◆ **Hospital:** Includes waste collected from the two on-campus hospitals.
- ◆ **Bulky Dump Truck:** Includes bulky and non-bulky trash collected throughout campus. The container is accessible to students, faculty, and staff.

Truck and container types sampled included front load trucks, compactors and open top roll-offs. For the purposes of this study it was not necessary to analyze results by truck/container type, only generator sector.

Table 2-1 shows the annual tonnage of solid waste and recycling disposed by the University of Kentucky's seven designated generator sectors using 2018 tonnage records provided by University staff. The Hospital contributes over 46 percent of the University's waste stream, disposing over 4,700 tons annually.

2. METHODOLOGY

Table 2-1 Solid Waste Annual Tonnage Disposed by Generator Sector and Recycling Rates

Generator Type	Solid Waste Tons	Percent of Solid Waste Stream
Front Loader Truck*	3,014	29.6%
General Campus	1,236	12.1%
Dorms	366	3.6%
Dining**	666	6.5%
Football Stadium	151	1.5%
Hospital	4,718	46.3%
Bulky Dump Truck	46	0.5%
Total	10,197	100.0%
Recycled/Diverted Tons	3,142	
Diversion Rate	31%	

*Excludes Football Game refuse

**Includes Kroger Field non-football game refuse.

It should be noted that the annual tonnage data provided by the University included campus building/locations that were not audited as part of this waste composition study. In order to align the study data with the total landfill tonnage reported in 2018, MSW Consultants made the categorizations presented in Table 2-2 of generator sectors not included in the study. The waste profiles for these sites may differ from the locations included in the study, which could result in an over or under estimation of tonnage contributions to the generator types included in Table 2-1.

Table 2-2 Campus Locations Excluded from Waste Composition Study

Generator Sector	Generator Type	Percent Contribution
PPD Greenhouse	General Campus	2.8%
Reynolds Warehouse	General Campus	1.6%
Ecological Research	General Campus	<0.1%
UK Medical Center Dock 2 Pav H Open Top	Hospital	6.1%
Main Chance Farm	General Campus	0.6%
Horticultural Research Farm	General Campus	0.7%
Center for Applied Energy	General Campus	0.4%
Midway Farm	General Campus	0.1%
Good Sam Chiller Building	Hospital	0.4%
Geological Survey Building	General Campus	0.1%
Misc Temp Roll Off Loads*	General Campus	0.8%
Transfer Station**	General Campus	0.6%

*C&D tonnage reported by University subtracted from Misc. Temp Roll Off Loads

**Excludes Bulky Dump Truck and UK Football Trucks

2.1.2 SAMPLING PLAN

Based on the tonnage distribution, MSW Consultants proposed to collect and sort 44 samples. Table 2-3 shows the targeted number of samples from each generator sector and the specific building or area of campus that was selected for sampling during the waste composition study.

Table 2-3 Sample Targets

Generator Sector	Total Samples	Generator Sector	Total Samples
Front Loader Truck	15	Dorms	5
Dining	4	Holmes Hall	1
Steak and Shake	1	University Flats North	1
Haggin Dining (K-Lair)	1	Haggin Hall	1
The 90	1	Lewis Hall	1
Student Center	1	Woodland Glenn 3	1
Football Stadium	4	General Campus	5
Kroger Field	2	White Hall	1
Frontload CKY	1	RB2	2
Frontload UofKY	1	Boyd Hall*	1
Hospital	10	Taylor Lot Open Top	1
Dock 1	3	Bulky Dump Truck	1
Dock 2	5		
Good Sam	2	Total	44

*Boyd Hall was selected for sampling, as instructed by University staff, when only one sample was able to be collected from White Hall before the load was pushed.

2.1.3 SEASONALITY

The University opted to perform the waste composition study in the fall semester of 2018 when school was in session to ensure a representative waste stream was available for characterization. MSW Consultants began sorting on a Monday to secure the collection of waste from the Football Stadium, following a Saturday home game. Sampling of all other generator sectors occurred throughout the week.

2.1.4 MATERIAL CATEGORIES

MSW Consultants worked with University staff to determine the preferred list of material categories to use for the characterization study. In total, there were 66 material categories to be used in the sort. The University expanded the material category list to include a number of medical waste categories for which there are on-campus recycling programs in place, such as plastic pitchers and basins, hospital textiles and other medical equipment. In addition, the University has recycling programs in place for single stream recycling, electronics and other hazardous waste. Table 2-4 shows the list of material categories used for the waste composition study. A complete list of material categories and definitions can be found in Appendix A.

2. METHODOLOGY

Table 2-4 Material Categories

Paper	
Corrugated Cardboard/Kraft Paper (Uncoated)	Hardbound Books
Office Paper (High Grade)	Aseptic Boxes & Gable Top Cartons
Mixed Recyclable Paper (Low Grade, ONP)	Compostable Paper
Magazines, catalogs, soft bound books	Remainder/Composite Paper
Plastics	
Plastics # 1 PET Bottles Only	#5 Christmas tree adaptors
Plastics #1 PET Non-bottle Containers	Plastic Film & Bags - Clean
Plastic # 2 (HDPE-clear/colored bottles & jugs)	Plastic Film & Bags - Other
Plastic Containers #3 thru #7	Data Storage Film
#4 Plastic Bottles	Expanded Polystyrene "Styrofoam"
#5 Pipette holders and lids	Polystyrene (Styrofoam) lab transport containers
#5 Hospital pitchers, basins, saline bottles	Remainder/Composite Plastic
Metal	
Aluminum Cans	Other Non-Ferrous (not magnetic)
Aluminum Containers, Plates and foils	Remainder/Composite Metal
Steel Cans & Containers	Refrigerators/Freezers
Other Ferrous (magnetic)	
Glass	
Glass Bottles and Jars (clear or colored)	Glass Lab Containers
Glass Containers - Non-Beverage	Remainder/Composite Glass
Organics	
Food Waste	Miscellaneous Organics
Yard Waste Grass, Leaves & Brush	Pallets
C&D Materials	
Wood – Treated	Brick, Concrete, and Rock
Carpet & Carpet Padding	Carpet & Carpet Padding
Asphalt	Drywall/Gypsum Board
Asphalt Roofing	Remainder/Composite Construction & Demolition
Household Hazardous Waste	
Household Hazardous Waste	Batteries
Aerosol cans	Ballasts
Medical Waste & Sharps	Lightbulbs
Treated Medical Waste	Paint
Electronics	
Small Consumer Electronics	Flat screen Televisions and Monitors
Computers and Related Electronics	CRT Televisions and Monitors
Other Wastes	
Textiles	Disposable Diapers & Sanitary Products
Hospital Textiles	Bottom Fines & Dirt
Rubber Products	Other Bulky Items
Old Furniture	Tires
Other Miscellaneous	

One of the primary objectives of any waste characterization study is to identify the fraction of the waste stream that could be recycled or otherwise diverted from disposal. However, it is important to clearly define what makes a particular material recoverable or not. Each of the above material categories has been

classified based on the ability to recycle or otherwise divert the material from disposal. Materials have been classified according to the following recoverability potential:

- ◆ **Single Stream Recycling:** Also known as the University’s “All-in-One-Stream” recycling program, this includes the collection of corrugated cardboard, fiber board/box board, office paper, newspaper, magazines, #1 and #2 plastics (plastic bottles and jugs), aluminum and steel cans, and glass bottles and jugs.
- ◆ **Other Targeted Recyclable:** Includes recyclable items in addition to single stream materials for which the University has already established a recycling program. Examples include various mixed plastics and textiles from the University’s medical complexes.
- ◆ **Potential New Recyclable:** Items that are not currently recycled but which may be recoverable if accumulated in sufficient volume, and for which there are likely local markets.
- ◆ **Compostables:** There is a significant volume of materials which are fully compostable if they can be source-separated and kept free of contamination. These include:
 - ◆ **Food**, as long as it is removed from all packaging;
 - ◆ **Green Waste**, including leaves, grass clippings, and small brush and prunings; and
 - ◆ **Compostable Paper**, which includes low-grade, non-recyclable papers such as napkins and paper towels.
- ◆ **Potential C&D Recyclable:** Includes construction and demolition (C&D) materials which could be recycled if source separated and collected in sufficient volume.
- ◆ **HHW/E-waste Recycling:** The University already separately collects certain electronic items and hazardous materials for recycling and/or appropriate disposal outside of the MSW stream such as televisions, computer hard drives, and batteries.
- ◆ **Non-Recoverable:** Materials that are not known to be recyclable in Fayette County, or for which no known local market exists. Some materials in this classification could theoretically become recyclable if sufficient material volume existed to create cost-effective and appropriate collection methods, processing facilities, and a suitable end market.

Note that it was beyond the scope of this study to determine if local markets exist for the potential new recyclables. Table 2-5 indicates how each of the materials have been classified. Results of the recoverability analysis are included in the next section.

2. METHODOLOGY

Table 2-5 Recoverability of Materials

Classification	Material Category	Classification	Material Category
Single Stream Recycling	Corrugated Cardboard/Kraft Paper (Uncoated)	Potential C&D Recyclable	Wood - Treated
	Office Paper (High Grade)		Wood - Untreated
	Mixed Recyclable Paper (Low Grade, ONP)		Asphalt
	Magazines, catalogs, soft bound books		Asphalt Roofing
	Plastics # 1 PET Bottles Only		Brick, Concrete, and Rock
	Plastic # 2 (HDPE-clear/colored bottles & jugs)		Carpet & Carpet Padding
	Aluminum Cans		Drywall/Gypsum Board
	Steel Cans & Containers		Household Hazardous Waste
	Glass Bottles and Jars (clear or colored)		Aerosol cans
Glass Containers - Non-Beverage	Treated Medical Waste		
Other Targeted Recyclable	#4 Plastic Bottles	HHW/E-Waste Recycling	Batteries
	#5 Pipette holders and lids		Ballasts
	#5 Hospital pitchers, basins, saline bottles		Lightbulbs
	#5 Christmas tree adaptors		Paint
	Data Storage Film		Small Consumer Electronics
	Glass Lab Containers		Computers and Related Electronics
	Hospital Textiles		Flat screen Televisions and Monitors
	Hardbound Books		CRT Televisions and Monitors
	Tires		Remainder/Composite Paper
	Pallets		Plastic Film & Bags - Other
	Other Ferrous (magnetic)		Expanded Polystyrene Styrofoam [™]
Other Non-Ferrous (not magnetic)	Remainder/Composite Plastic		
Potential New Recyclable	Aseptic Boxes & Gable Top Cartons	Non-Recoverable	Remainder/Composite Metal
	Plastics #1 PET Non-bottle Containers		Remainder/Composite Glass
	Aluminum Containers, Plates and Foils		Miscellaneous Organics
	Plastic Containers #3 thru #7		Remainder/Composite C&D
	Plastic Film & Bags - Clean		Mixed Medical Facility Waste
	Polystyrene (Styrofoam) lab containers		Rubber Products
	Refrigerators/Freezers		Disposable Diapers & Sanitary Products
	Textiles		Bottom Fines & Dirt
Compostable Paper	Compostable Paper		Other Bulky Items
Compostable Food	Food Waste		Old Furniture
Compostable Green Waste	Yard Waste Grass, Leaves & Brush		Other Miscellaneous

2.2 FIELD DATA COLLECTION

The University of Kentucky, Central Kentucky Hauling and Bluegrass Transfer Station staff worked together to provide the on-time delivery of pre-selected trucks to the sort site for MSW Consultants.

2.2.1 SAMPLE SELECTION

Upon arrival of a pre-selected truck the Field Supervisor interviewed the driver to obtain the generator sector, truck number, and net weight of the load to be sampled. The Field Supervisor then worked with transfer station staff to obtain a sample. Once the load was tipped in the designated area, the Field Supervisor worked with the onsite loader operator to select an area of the pile for sampling. From each selected load, one to three samples were collected based on the pre-determined sampling counts. Samples were selected based on systematic “grabs” from the perimeter or cross-section of the load.

Once the area of the pile to sample from was selected the transfer station loader operator brought a full bucket to the Field Supervisor. Bulky items were accounted for by estimating the fraction of the item that was in the sampling cell and applying the fraction of the overall weight to the overall sample. From the loader bucket the Field Supervisor raked material for sorting into 35-gallon barrels the full depth of the

loader bucket until 200-250 pounds was achieved. The Field Supervisor then used a placard to assign a unique sample ID to the set of barrels and staged the sample for sorting.

2.2.2 SORTING

Once the sample had been selected and pre-weighed the Crew Chief from MSW Consultants emptied the sample barrels onto the sort table. Samples were sorted into the designated material categories using 5 gallon buckets, 18 gallon bins, and 35 gallon barrels that each had a unique label. A picture of the sorting table and bins is shown in Figure 2-1.

Figure 2-1 Sort Table and Bins



The MSW Consultants Crew Chief and Field Supervisor trained locally hired sorters to specialize in separating the material categories into the correct bins. The Crew Chief continually monitored the bins as each sample was sorted, reassigning materials that were improperly classified. The materials were sorted to a particle size of 2-inches or less, until no more than a small amount of homogeneous material remained. This layer of mixed 2-inch-minus material was allocated to the appropriate categories based on the best judgment of the Crew Chief—most often a combination of Compostable or Remainder/Composite Paper, Food Waste, Remainder/Composite Plastic, Miscellaneous Organic or Bottom Fines and Dirt.

2.2.3 DATA RECORDING

After each sample was sorted in its entirety, all bins containing any material were weighed out at the digital scale and recorded in the electronic tablet by the Crew Chief. The tablet allowed for the Crew Chief and Field Supervisor to QA/QC the pre- and post-sort weights in the field to ensure there were no major discrepancies as well as highlighting any errors in material weight entries using the built-in logic of the data spreadsheets.

After the weigh-out, bins were emptied into the correct dumpster – recycling or solid waste – for proper disposal by the University and transfer station. Bins were then reset in the same locations around the table before starting the next sample.

2.2.4 DATA ANALYSIS

At the conclusion of each day in the field, the sort data from the electronic tablet was synced to MSW Consultants cloud-based data management system on www.wasteinsight.net. Sort data and photographs from the composition analysis are stored on this system, and the University will be provided with a login and user identification code to view and analyze the data and photographs. Upon return from the field, the data was statistically analyzed to determine the estimated weight and estimated mean percent associated with each material in the samples and the generator sector. These results are presented in the next section.

2. METHODOLOGY

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3. RESULTS

3.1 COMPOSITION

This section presents the findings of the solid waste composition study conducted in October 2018 for the University of Kentucky. Results in this section focus on the aggregate campus-wide findings, using weighted averages of the composition contributed by each generator sector presented in Table 2-1 in the Methodology section. Detailed statistical results by generator sector can be seen in Appendix B.

The aggregate MSW stream is the sum of the seven generator sectors present at the University, which include the Front Loader Truck route, General Campus, Dorms, Dining, Football Stadium, Hospital, and Bulky Dump Truck.

Figure 3-1 shows the percent composition by material group for the aggregate University waste stream. A catch-all category termed “Other” was found to be the most prevalent material group, driven by the inclusion of mixed medical facility wastes (discussed later in this section). Paper, Plastic, and Organics also made up a significant fraction of disposed wastes.

Figure 3-1 Weighted Aggregate Composition by Material Group

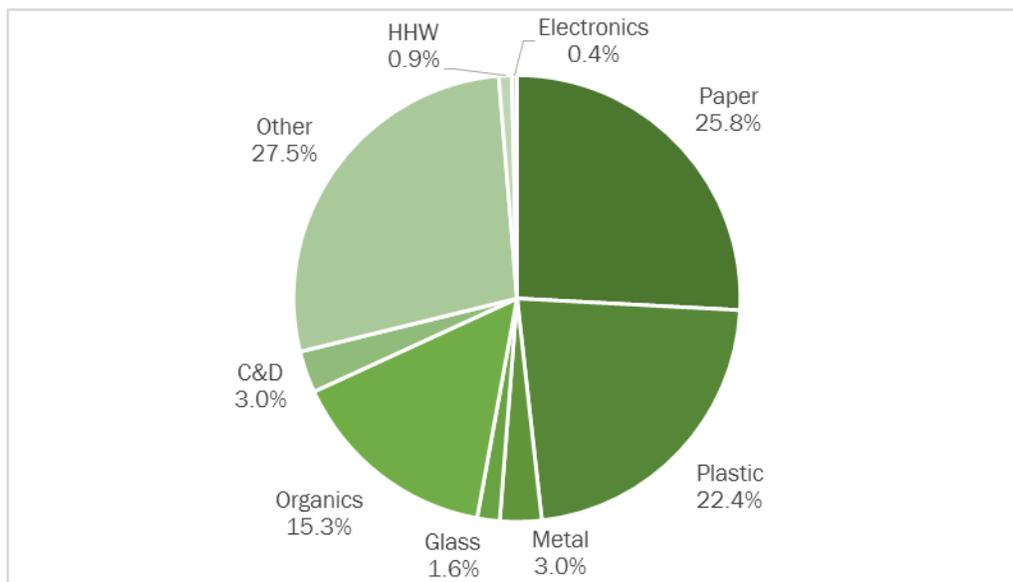
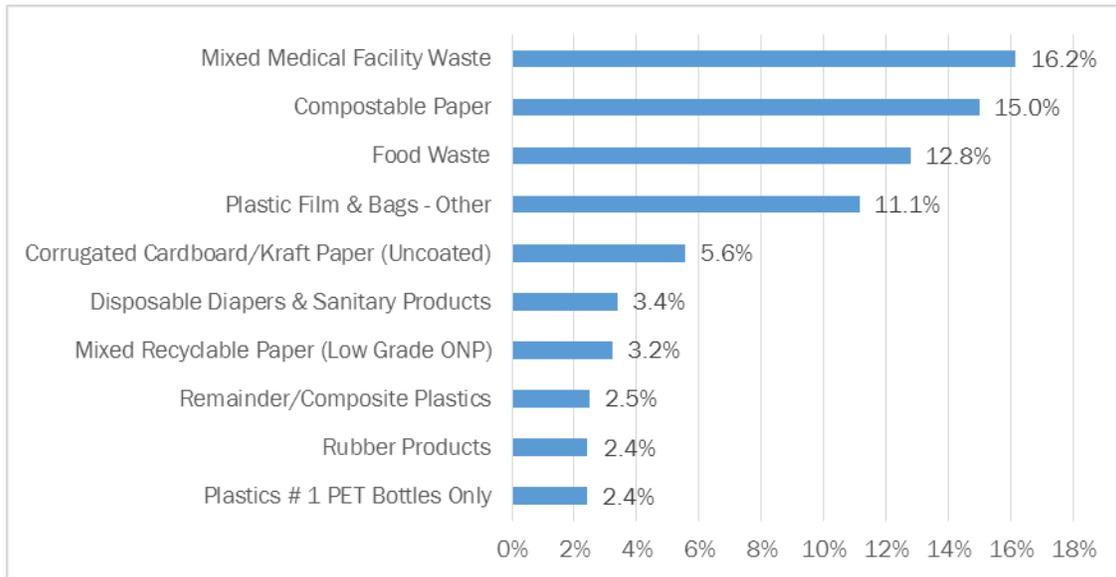


Figure 3-2 shows the 10 most prevalent materials in the University’s waste stream.

3. RESULTS

Figure 3-2 Top 10 Materials in University Landfilled Waste



Mixed Medical Facility Waste is the largest individual contributing material category due to the presence of miscellaneous medical waste from the Hospital, Front Loader and General Campus generator sectors. As discussed with University staff and included in the proposed Sampling Plan, bagged medical waste such as tubing, gauze, bandaging, rags, and other laboratory and medical paraphernalia is allowable in the municipal solid waste (MSW) stream as long as it is not overly contaminated with human or animal blood or other bodily fluids. Due to the risks of contamination with these items and because of the potential for the existence of sharps, it was agreed that this material would not be extensively sorted, but rather sorted into a catch-all category of medical waste. MSW Consultants attempted to remove any hospital textiles or targeted hospital plastics (pitchers, basins, bottles and pipette holders) to capture these weights, but otherwise did not further sort the material. Visual observations suggest that this material consists of miscellaneous film and rigid plastics, textiles, and mixed metals.

It should be noted that medical waste heavily contaminated with blood or other bodily fluids was observed in the Mixed Medical Facility Waste category during sorting. This type of waste was improperly disposed and represents a liability to the University if it continues to be disposed in the MSW stream. Further, it is possible that contaminated material should have been captured in existing biomedical disposal programs and not contributed to the landfill waste stream.

Compostable Paper and Food Waste are the next two most disposed material categories at 15.0 and 12.8 percent, respectively, indicating a potential opportunity to recover these materials and divert them from the landfill waste stream.

Table 3-1 shows the detailed statistical results for the weighted aggregate University waste stream. For each material category, the mean composition percent and confidence intervals are shown. Confidence intervals are calculated at a 90 percent level of confidence. It should be noted that the sum of the mean percentages for all of the individual materials within a material group sum to the mean percentage shown for the group, though sums may be slightly different due to rounding. For example, the sum of all of the paper materials is the same as the 25.8 percent shown for Paper as a material group. However, the same does not hold true for the confidence intervals. Confidence intervals are calculated individually for each row in this table; the sum of the confidence intervals for each individual material will not equal the confidence interval for the material group as a whole.

Table 3-1 Detailed Waste Composition

Material Category	Est. Percent	Conf. Int (+/-)	Tons	Material Category	Est. Percent	Conf. Int (+/-)	Tons
Paper	25.8%	3.0%	2,634	Organics	15.3%	2.8%	1,559
Corrugated Cardboard/Kraft Paper	5.6%	1.9%	566	Food Waste	12.8%	2.8%	1,303
Office Paper (High Grade)	0.4%	0.3%	40	Yard Waste Grass/Leaves/Brush	1.2%	1.2%	123
Mixed Recyclable Paper	3.2%	0.6%	328	Miscellaneous Organics	1.3%	0.9%	131
Magazines, catalogs, soft bound books	0.5%	0.4%	50	Pallets	0.0%	0.0%	1
Hardbound Books	0.1%	0.1%	10	C&D	3.0%	1.7%	308
Aseptic Boxes & Gable Top Cartons	0.2%	0.0%	17	Wood - Treated	0.6%	0.6%	64
Compostable Paper	15.0%	2.2%	1,528	Wood - Untreated	0.2%	0.3%	23
Remainder/Composite Paper	0.9%	0.3%	94	Asphalt	0.0%	0.0%	0
Plastic	22.4%	1.2%	2,283	Asphalt Roofing	0.0%	0.0%	0
Plastics # 1 PET Bottles Only	2.4%	0.6%	246	Brick, Concrete, and Rock	0.1%	0.1%	13
Plastics #1 PET Non-bottle Containers	0.3%	0.1%	34	Carpet & Carpet Padding	0.3%	0.4%	26
Plastic # 2 (HDPE bottles & jugs)	0.7%	0.2%	72	Drywall/Gypsum Board	0.2%	0.1%	18
Plastic Containers #3 thru #7	2.2%	0.3%	221	Remainder/Composite C&D	1.6%	1.1%	163
#4 Plastic Bottles	0.0%	0.0%	3	HHW	0.9%	0.7%	96
#5 Pipette holders and lids	0.1%	0.1%	9	Household Hazardous Waste	0.1%	0.1%	7
#5 Hospital pitchers/basins/bottles	1.8%	0.4%	186	Aerosol cans	0.1%	0.1%	7
#5 Christmas tree adaptors	0.0%	0.1%	4	Treated Medical Waste	0.7%	0.6%	75
Plastic Film & Bags - Clean	0.1%	0.2%	12	Batteries	0.0%	0.0%	5
Plastic Film & Bags - Other	11.1%	0.8%	1,137	Ballasts	0.0%	0.0%	0
Data Storage Film	0.0%	0.0%	4	Lightbulbs	0.0%	0.0%	0
Expanded Polystyrene Styrofoam™	1.0%	0.2%	101	Paint	0.0%	0.2%	2
Polystyrene (Styrofoam) lab containers	0.0%	0.0%	4	Electronics	0.4%	0.6%	37
Remainder/Composite Plastic	2.5%	0.5%	252	Small Consumer Electronics	0.1%	0.1%	13
Metal	3.0%	0.7%	307	Computers & Related Electronics	0.0%	0.0%	4
Aluminum Cans	0.6%	0.2%	63	Flat Screen TVs & Monitors	0.2%	0.4%	20
Aluminum Containers, Plates and foils	0.4%	0.2%	36	CRT TVs and Monitors	0.0%	0.0%	0
Steel Cans & Containers	0.5%	0.3%	47	Other	27.5%	4.6%	2,806
Other Ferrous (magnetic)	0.7%	0.6%	75	Mixed Medical Facility Waste	16.2%	3.3%	1,647
Other Non-Ferrous (not magnetic)	0.2%	0.2%	24	Textiles	2.1%	0.5%	212
Remainder/Composite Metal	0.5%	0.2%	48	Hospital Textiles	0.5%	0.2%	56
Refrigerators/Freezers	0.1%	0.1%	14	Rubber Products	2.4%	0.5%	247
Glass	1.6%	0.8%	166	Diapers/Sanitary Products	3.4%	1.0%	345
Glass Bottles and Jars (clear or colored)	1.6%	0.8%	161	Bottom Fines & Dirt	1.4%	0.3%	144
Glass Containers - Non-Beverage	0.0%	0.0%	1	Other Bulky Items	0.5%	0.4%	49
Glass Lab Containers	0.0%	0.0%	1	Old Furniture	0.0%	0.0%	0
Remainder/Composite Glass	0.0%	0.1%	3	Tires	0.0%	0.0%	0
				Other Miscellaneous	1.0%	0.4%	106
				Grand Total	100.0%		10,197
				<i>No. of Samples</i>	44		

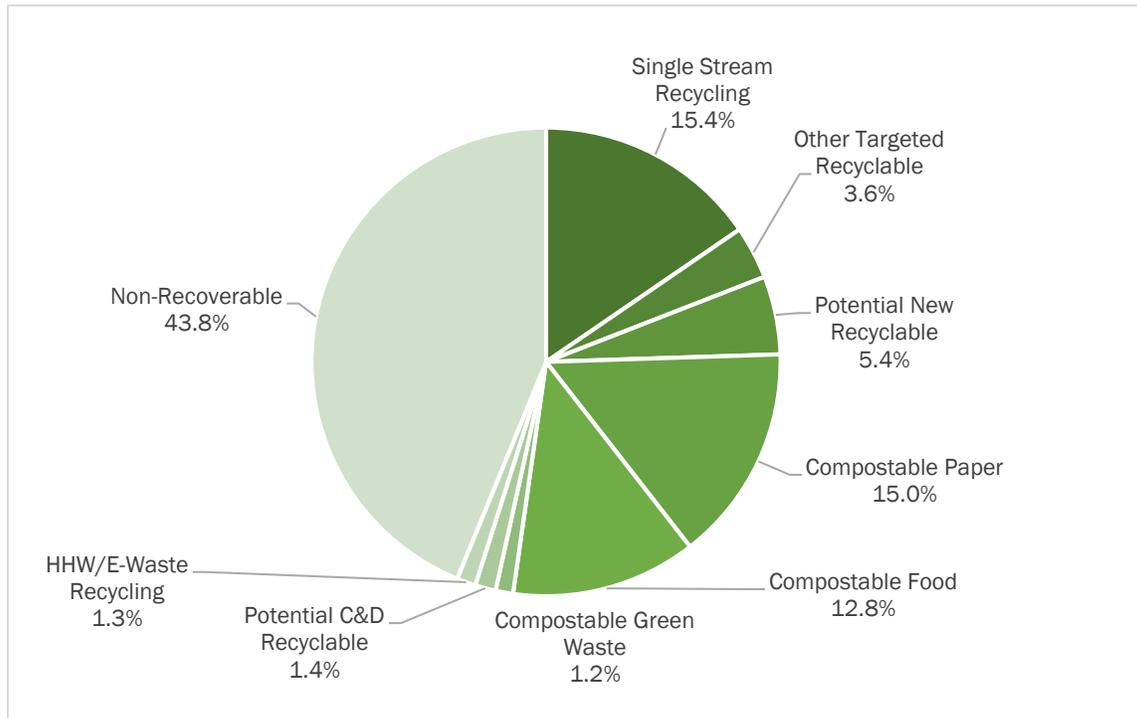
The detailed composition data for each generator sector is provided in Appendix B.

3.2 RECOVERABILITY

The waste composition study identified that large quantities of single stream recyclables and other materials targeted in existing University recycling programs are making their way to the landfill waste stream. Figure 3-3 shows the recoverability potential of waste currently disposed by the University. Although almost 44 percent of the University's waste stream is designated as Non-Recoverable, just over 56 percent of the material currently disposed could be recycled or composted.

3. RESULTS

Figure 3-3 Weighted Aggregate Recoverability



The following observations are offered about the incidence of recoverable items in the disposed waste stream:

- ◆ **Composting:** Over one quarter of the disposed waste stream could be composted if it were possible to source separate the material. As a practical matter, it is not possible to capture all of this compostable material. However, back-of-house food wastes and green wastes should be readily separable for eventual composting. Additionally, back-of-house staff should do their best to only produce the food that will be sold. In particular, from the Football Stadium, large quantities of unused foods such as sausages/hot dogs and cotton candy were observed, as shown in Figure 3-4.

Figure 3-4 Unused Food



Diverting all of this compostable material would require significant behavior change by students, faculty, staff and visitors. An intermediate behavior change that should be implemented is that the sort crew observed throughout many samples that paper towel and toilet paper rolls were being

disposed well before they were close to the end of the roll, as shown in Figure 3-5. Custodial staff should be instructed not to dispose of rolls prior to their end while facility users should be comfortable with using up the available paper. This could lower the amount of disposed compostable paper while creating savings for the University.

Figure 3-5 Unused Paper Towel and Toilet Paper Rolls



- ◆ **Single Stream Recycling:** Over 15 percent of the disposed wastes could be recycled in the existing single stream programs on campus. This suggests that ongoing education and placement of appropriate recycling containers remains important to the campus recycling effort.
- ◆ **Limited Opportunities for New Programs:** Although there were several materials that could be incrementally diverted, these did not occur in large quantity and do not offer significant gains in the University diversion rate.
- ◆ **Non-Recoverable:** The non-recoverable fraction, driven largely by Mixed Medical Facility Wastes, is quite large. Longer term, it may become necessary to develop diversion programs for at least some of this waste fraction to achieve exceptionally high diversion rates. Ensuring heavily contaminated waste is disposed of in the existing biomedical disposal program will assist in diverting this material.

3.3 CAPTURE RATE

The University currently recycles a variety of materials through their All-in-One single stream recycling program as well as various programs to collect hospital plastics, electronics, scrap metals, batteries/bulbs, and some organics. Figure 3-6 shows the capture rates for the University's existing recycling programs. Appendix C provides the detailed disposal and recycling tonnage by material category, as well as individual capture rates.

3. RESULTS

Figure 3-6 Current Capture Rates by Diversion Program

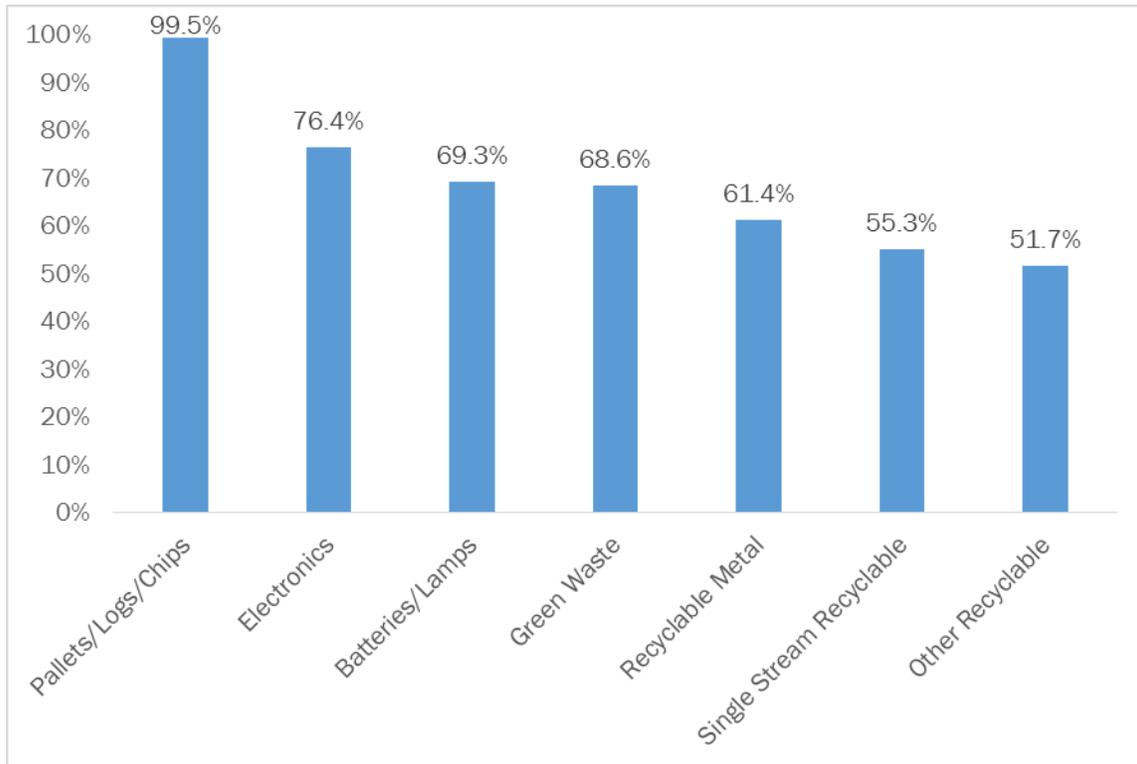


Table 3-2 presents the underlying data depicted in Figure 3-6. The University is doing well in the recycling of Pallets/Logs/Chips, Batteries/Lamps (Lightbulbs), Electronics, Green Waste, Recyclable (Scrap) Metal, and Single Stream Recycling. Appendix C shows the material categories included in each disposal category. Opportunities to expand the single stream recycling program to capture more materials from all generator sectors as well as an expansion of the program to include additional materials should be explored. Additionally, opportunities to capture food waste could divert a significant amount of material from the disposed waste stream. These recommendations are further discussed in the next section.

The Other Recyclable material category has a capture rate of 51.7 percent. This Capture Rate is pulled down by the limited recycling of #5 hospital plastics and blue wrap. This is likely due to the fact that many of these plastics and blue wrap are disposed along with contaminated wastes. The sort staff observed that many of these materials were clean enough for recycling. It is suspected that hospital rooms/trays are often cleaned with one trash bag with no separation of recoverable recyclables. Additionally, the sort staff observed that many #5 plastic pitchers are placed inside of expanded polystyrene cups (believed to capture condensation); if medical staff could remove these cups and recycle the pitchers correctly this could aid in the capture of these materials.

Table 3-2 Current Capture Rates

Material Category	Disposed Tons	Recycled Tons	Generated Tons	Capture Rate
Single Stream Recyclable	1,574	1,945	3,519	55.3%
Other Recyclable	214	229	444	51.7%
Recyclable Metal	196	312	508	61.4%
Electronics	37	119	156	76.4%
Batteries/Lamps	5	11	15	69.3%
Green Waste	123	269	392	68.6%
Pallets/Logs/Chips	1	257	258	99.5%
Food Waste	1,303	0	1,303	0.0%
Disposed	6,742	0	6,742	0.0%
	10,197	3,142	13,339	23.6%

Conclusions and recommendations are offered in the next section.

3. RESULTS

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4. CONCLUSIONS

4.1 CONCLUSIONS

With over 10,000 tons of solid waste delivered to the landfill in 2018 it is important for the University to understand the types and quantities of material being sent to the landfill. Material composition analysis was conducted in a representative manner of the seven sources of waste on campus: Front Loader Truck, General Campus, Dorms, Dining, Football Stadium, Hospital, and Bulky Dump Truck. We offer the following conclusions:

- ◆ **Inaugural Study:** This Study served as a good first effort to measure the composition of disposed municipal solid waste originating at the University of Kentucky. The study captured samples of wastes in proportion to the generation of such wastes across different sources. In the opinion of MSW Consultants, the disposed waste composition estimates appear reasonable compared to other institutions that have characterized their waste stream, although the aggregate results are influenced heavily by the large fraction of wastes generated in the campus medical facilities.
- ◆ **Current Recycling Programs:** The University has a robust on-campus recycling program including the recovery of single stream recyclables, selected materials from medical complexes, electronics, and other hazardous materials. However, some single stream recyclables and other targeted recyclables are still being disposed in the waste stream.
- ◆ **Opportunity for Diversion of Organics:** Roughly one quarter of the disposed waste stream is made up of compostable food, green wastes and low grade (non-recyclable) paper. While source separation of these materials could be challenging in some areas of the University, opportunities exist to increase diversion of organics
- ◆ **Possible Improper Disposal:** Based on the samples obtained for this study, some improper wastes from the medical complex may be making their way into the landfilled MSW stream.

4.2 RECOMMENDATIONS

The following recommendations may be considered by the University of Kentucky as it ponders enhancements to its waste management program.

- ◆ **Expansion of Single Stream Recycling:** The University may consider the opportunity to expand the existing single stream recycling program to cover all areas of campus. That is, if there are not single stream recycling containers in all areas of campus, as well as recycling dumpsters adjacent to solid waste dumpsters, the University should increase the quantity of recycling containers to ensure the capture of all single stream recycling from all generator sectors.
- ◆ **Implementation of Organics Collection:** The large quantity of compostable material, particularly Food Waste and Compostable Paper, currently disposed by the University presents a significant opportunity to divert a large portion of the existing waste stream. The University should research opportunities for implementing a composting collection program in the Lexington area.
- ◆ **New Recycling Programs:** The University is currently accepting single stream recycling as well as a variety of medical, electronic and hazardous waste materials. Adding materials such as C&D, clean film plastic, white goods, and non-hospital textiles are possible recoverable recyclables that could reduce the amount of material going to landfill. However, given the relatively small contribution of these items to the University's current landfilled waste stream, the impact on diversion may be minimal.
- ◆ **In-house Training and Outreach:** The presence of single stream recyclables such as Corrugated Cardboard, Mixed Recyclable Paper, PET Plastics, Metal Cans, and Glass Bottles in the waste stream suggest the improper disposal of these recyclables. This may be due to a lack of collection infrastructure as discussed above but may also be due to students, faculty and staff improperly

4. CONCLUSIONS

discarding recyclables in solid waste containers. This suggests a need for improved signage on recycling containers, outreach to students and faculty on existing programs and training/re-training of staff to ensure they are using the correct dumpsters for disposal. Mixed Medical Facility Wastes were also found in the waste stream, including both targeted recyclables, such as #5 Plastics and Hospital Textiles, and contaminated medical waste that should have been disposed in a separate program. Therefore, it is recommended that the University work with medical staff at the on-campus hospitals, laboratories and research buildings to ensure staff are properly recycling and disposing of these materials.

- ◆ **Perform Generator-specific Waste Audits:** Though this study is representative of the University's landfill waste stream, additional insight is likely available through building-specific and generation point-specific waste and recycling audits. A building-specific waste audit differs from a waste composition study in that it focuses on all of the generated materials – including both disposed wastes as well as mixed recyclables – for a one-day time period and provides a detailed drill-down into the generating, recycling and disposal behaviors taking place within the building. A waste audit also identifies the recycling container and signage infrastructure within the building to assess how effective such infrastructure is at achieving diversion. The University may wish to consider conducting audits at buildings believed to have the highest opportunity for incremental diversion. The detailed results in Appendix B may identify some starting points.

APPENDIX A
MATERIAL CATEGORIES AND DEFINITIONS

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2018 University of Kentucky Waste Characterization Study
Material Definitions

1 CORRUGATED CARDBOARD/KRAFT PAPER (UNCOATED): Corrugated boxes or paper bags made from Kraft paper. Wavy center layer sandwiched between two outer layers without wax coating on the inside or outside. Examples include cardboard shipping containers and moving boxes, computer packaging cartons, and sheets and pieces of boxes and cartons. Does not include chipboard. Examples of Kraft paper include paper grocery bags, unsoiled fast food bags, department store bags, and heavyweight sheets of Kraft packing paper.

2 OFFICE PAPER (HIGH GRADE): Paper that is free of ground wood fibers; usually sulfite or sulphate paper; includes office printing and writing papers such as white ledger, color ledger, envelopes, and computer printout paper, bond, rag, or stationary grade paper. This subtype does not include fluorescent-dyed paper or deep-tone dyed paper such as goldenrod colored paper.

3 MIXED RECYCLABLE PAPER (LOW GRADE, ONP): Recyclable paper other than the paper mentioned above. Examples include newspaper, manila folders, manila envelopes, index cards, white envelopes, white window envelopes, notebook paper, carbonless forms, junk mail, chipboard and uncoated paperboard, groundwood paper, and deep toned or fluorescent dyed paper, cereal, show, and gift boxes.

4 MAGAZINES, CATALOGS, SOFT BOUND BOOKS: Glossy paper magazines or catalogs; Bound books bearing a soft cover. Includes phone books

5 HARDBOUND BOOKS: Thin paper books bound between a hard book cover.

6 ASEPTIC BOXES & GABLE TOP CARTONS: Aseptic containers (multi-layered packaging that contains shelf-stable food products such as apple juice, soup, soy/rice milk, etc.) and "gable top" cartons (non-refrigerated items such as granola and crackers; refrigerated items such as milk, juice, egg substitutes, etc.). Rigid food and beverage cartons are usually paper-based, may be any shape, and may include a plastic pour spout as part of the carton.

7 COMPOSTABLE PAPER: Low-grade, biodegradable paper that cannot be recycled, as well as food contaminated paper. Examples include paper towels, paper plates, waxed papers and waxed cardboard, and tissues.

8 REMAINDER/COMPOSITE PAPER: Products made mostly of paper but combined with large amounts of other materials such as plastic, metal, glues, foil, and moisture. Examples include corrugated cardboard coated with plastic, cellulose insulation, blueprints, sepia, onion skin, foil lined fast food wrappers, frozen juice containers, carbon paper, selfadhesive notes, softcover and hardcover books, and photographs.

9 PLASTICS # 1 PET BOTTLES ONLY: Clear or colored PET bottles (may have state deposit markings). The plastic resin number "1" is visible in the center of the triangular recycling symbol and may also bear the letters "PETE" or "PET". A PET container usually has a small dot left from the manufacturing process, not a seam. It does not turn white when bent. This category only includes PET bottles or jars that did not previously contain hazardous materials.

10 PLASTICS #1 PET NON-BOTTLE CONTAINERS: Non-bottle containers such as PET jars, rectangular PET clamshell or tray containers used for produce; etc. The plastic resin number "1" is visible in the center of the triangular recycling symbol and may also bear the letters "PETE" or "PET". The color is usually transparent, green, or clear.

2018 University of Kentucky Waste Characterization Study
Material Definitions

11 PLASTIC # 2 (HDPE - CLEAR, COLORED BOTTLES AND JUGS ONLY): Natural colored HDPE bottles/jars. This plastic is usually either cloudy white, allowing light to pass through it (natural). When marked for identification, it bears the number "2" in the triangular recycling symbol and may also bear the letters "HDPE. This category only includes HDPE containers that did not previously contain hazardous materials. Includes natural buckets, pails or paint cans made of HDPE and designed to hold 5 gallons or less of material. Colored HDPE bottles/jars. In contrast with natural HDPE, the colored HDPE is usually a solid color and opaque. When marked for identification, it bears the number "2" in the triangular recycling symbol and may also bear the letters "HDPE." This category only includes HDPE bottles that did not previously contain hazardous materials.

12 PLASTIC CONTAINERS #3 THRU #7 : Tubs, Cups, and Lids. Containers made of types of plastic other than HDPE or PET. Items may be made of PVC, PP, or PS. When marked for identification, these items may bear the number 3, 4, 5, 6, or 7 in the triangular recycling symbol. This subtype also includes unmarked plastic containers. This category only includes plastic #3-#7 containers that did not previously contain hazardous materials. Also, this category does NOT include Hospital-related #5 plastics (see Categories 14 and 15).

13 #4 PLASTIC BOTTLES: Hospital-related plastic bottles bearing the #4 resin number.

14 #5 PIPETTE HOLDERS AND LIDS: Plastic stands and holders for holding pipettes (any type)

15 #5 HOSPITAL PITCHERS, BASINS, SALINE BOTTLES: Hospital pitchers, basins, saline bottles bearing the #5 plastic resin number.

16 #5 CHRISTMAS TREE ADAPTORS: Small green plastic adapters – about 2 inches long.

17 PLASTIC FILM & BAGS - CLEAN: Clean film plastic retail bags used to contain merchandise to transport from the place of purchase, given out by the store with the purchase. Also includes dry-cleaning plastic bags intended for one-time use, and non-bag commercial and industrial packaging film used for large-scale packaging or transport packaging. Examples include shrink-wrap, mattress bags, furniture wrap, and film bubble wrap.

18 PLASTIC FILM & BAGS - OTHER: Plastic film or bags that are contaminated or otherwise non recyclable. Examples include garbage bags, contaminated shopping bags, and other types of plastic bags (sandwich bags, zip (recloseable) bags, produce bags, frozen vegetable bags), flexible plastic packaging, painting tarps, food wrappers such as candy bar wrappers.

19 DATA STORAGE FILM : X-ray films, and CDs, DVD, VHS tapes, and other film type material (data storage)

20 EXPANDED POLYSTYRENE "STYROFOAM": Food and Non-food packaging. Includes clamshell "Styrofoam" food containers, as well as cups, plates, and bowls. Includes finished products made of expanded polystyrene such as block Styrofoam padding and packing peanuts.

21 POLYSTYRENE (STYROFOAM) LAB TRANSPORT CONTAINERS: Expanded polystyrene containers typically used to transport cold-pack laboratory shipments.

22 REMAINDER/COMPOSITE PLASTIC: Plastic that cannot be put in any other type or subtype. Includes items made mostly of plastic but combined with other materials. Examples include auto parts made of plastic attached to metal, plastic drinking straws, produce trays, foam packing blocks (not including expanded polystyrene blocks), plastic strapping, new plastic laminate (e.g. Formica), vinyl, linoleum, plastic lumber, imitation ceramics, handles and knobs, plastic lids, some kitchen ware, toys, plastic string (as used for hay bales), and plastic rigid bubble/foil packaging (as for medications); durable plastic such as plastic outdoor furniture, plastic toys and sporting goods, CDs, and rigid plastic housewares (such as mop buckets), dishes, cups, and cutlery.

2018 University of Kentucky Waste Characterization Study

Material Definitions

- 23 ALUMINUM CANS: Aluminum beverage containers (may have state deposit markings).
- 24 ALUMINUM CONTAINERS, PLATES AND FOILS: Aluminum food containers, includes cat food cans, aluminum pie plates and non-rigid baking pans, as well as aluminum foils.
- 25 STEEL CANS & CONTAINERS: Steel or tin food or other containers including empty steel aerosol containers.
- OTHER FERROUS (MAGNETIC): Any other iron or steel that is magnetic. This subtype does not include steel cans or containers for food. Examples include empty or dry paint cans, structural steel beams, boilers, metal clothes
- 26 hangers, metal pipes, some cookware, security window bars, scrap ferrous items and galvanized items such as nails and flashing. This category also includes mixed metal items made of both ferrous metal and non-ferrous metal combined. Examples include small non-electronic appliances such as toasters and motors.
- OTHER NON-FERROUS (NOT MAGNETIC): Any metal item that is not magnetic, as well as stainless steel.
- 27 These items may be made of copper, brass, bronze, lead, zinc, or other metals. Examples include copper wire, shell casings, and brass pipe.
- REMAINDER/COMPOSITE METAL : Items made mostly of metal but combined with other materials (such as
- 28 plastics, wood, etc.). Examples: hair dryers, insulated wire, and finished products that contain a mixture of metals and other materials, whose weight is derived significantly from the metal portion of its construction.
- 29 REFRIGERATORS/FREEZERS: Refrigerators or freezers of any type or size.
- GLASS BOTTLES AND JARS (CLEAR OR COLORED): Includes all non-deposit glass beverage containers,
- 30 regardless of color (may include deposit markings from other states). Includes examples such as wine bottles, beer and soft drink bottles.
- 31 GLASS CONTAINERS - NON-BEVERAGE: All glass non-beverage containers, such as those for mayonnaise, jam jars, and other food and non-food products. Does not include laboratory glass (see Category #32).
- 32 GLASS LAB CONTAINERS: Laboratory glassware, including Pyrex type lab materials.
- REMAINDER/COMPOSITE GLASS : Glass that cannot be put in any other type. It includes items made mostly
- 33 of glass but combined with other materials. Examples include Pyrex (non-lab), Corningware, crystal and other glass tableware, mirrors, non-fluorescent light bulbs, auto windshields, laminated glass, or any curved glass. Uncoated plate glass - includes window and door glass, table-tops, and some auto glass (side windows).
- FOOD WASTE: Food wastes and scraps, including meat, bone, dairy, grains, rinds, teabags, coffee grounds with
- 34 filters, etc. Excludes the weight of food containers, except when container weight is not appreciable compared to the food inside. Compostable peanuts, food packaging with food scraps, and small wooden produce crates are also included in this category.
- YARD WASTE GRASS, LEAVES & BRUSH: Plant material, including woody material, from any public or
- 35 private landscapes. Examples include leaves, grass clippings, plants, brush and branch prunings, trimmings & stumps.
- 36 MISCELLANEOUS ORGANICS: Organic material that is not food or yard waste. Includes cork, popsicle sticks, hair, animal waste, cigarette butts, chopsticks, woven baskets, and small non-construction related wood products.
- 37 PALLETS : Painted/treated and Unpainted/untreated wood from pallets, either whole or broken. Does not include pallets made from other materials, such as plastic.
- 38 WOOD – TREATED: Wood that contains an adhesive, paint, stain, fire retardant, pesticide or preservative. Does not include wood furniture.
- WOOD – UNTREATED : Any wood which does not contain an adhesive, paint, stain, fire retardant, pesticide or
- 39 preservative; includes such items as bulky wood waste or scraps from newly built wood products. Does not including land clearing debris or yard waste prunings and trimmings.
- 40 ASPHALT: Includes asphalt paving materials, set or unset.

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Material Definitions

- 41 ASPHALT ROOFING: Composite shingles and other roofing material made with asphalt. Examples include asphalt shingles and attached roofing tar and tar paper.
- 42 BRICK, CONCRETE, AND ROCK: Includes all types of fire-clay bricks. Includes Portland cement mixtures (set or unset), with or without aggregate materials (gravel, etc.). Includes rock gravel larger than 2" in diameter.
- 43 CARPET & CARPET PADDING: Flooring applications consisting of various natural or synthetic fibers bonded to some type of backing material. Carpet padding may include plastic, foam, felt, or other material used under the carpet to provide insulation and padding.
- 44 DRYWALL/GYPSUM BOARD: Interior wall covering made of a sheet of gypsum sandwiched between paper layers. Examples include used or unused, broken or whole sheets of sheetrock, drywall, gypsum board, plasterboard, gypsum board, gyproc, and wallboard.
- 45 REMAINDER/COMPOSITE CONSTRUCTION & DEMOLITION : Construction and demolition material that cannot be put in any other type or subtype. This type may include items from different types combined, which would be very hard to separate. Also includes fiberglass insulation, ceramic fixtures, and other miscellaneous C&D Materials not mentioned above.
- 46 HOUSEHOLD HAZARDOUS WASTE: Hazardous household items containing paints, thinners, solvents, vehicle equipment fluids, cleaners, pesticides/herbicides and fertilizers. Includes fluorescent bulbs and CFLs, or mercury-containing devices.
- 47 AEROSOL CANS: Empty or full aerosol cans of any material.
- 48 MEDICAL WASTE & SHARPS : Treated or untreated medical waste. Includes bandages, gauze, diabetic strips, syringes, needles, other sharps, fluid filled medical bags, and medical tubing. Includes similar items from veterinary usage, medical research, or industrial laboratories.
- 49 TREATED MEDICAL WASTE: Bags of medical waste specifically labelled as "Treated" or showing an "Autoclaved" marking. These bags will not be opened, but placed directly in the sorting bin.
- 50 BATTERIES: All batteries, including "dry" type, rechargeable, and lead-acid batteries.
- 51 BALLASTS: Fluorescent light ballasts - metal box type voltage regulator for fluorescent lighting fixtures.
- 52 LIGHTBULBS: Incandescent type light bulbs for indoor or outdoor lighting. Does not include CFLs
- 53 PAINT: Liquid paints of water or oil-based variety. Dried paints within the container are sorted as mixed C&D waste.
- 54 SMALL CONSUMER ELECTRONICS: Includes personal computers, laptop computers, notebook computers, processors, keyboards, etc. Includes stereos, VCRs, DVD players, etc. This category does not include automated typewriters or typesetters.
- 55 COMPUTERS AND RELATED ELECTRONICS: Desktop or laptop computer systems, including removed hard drives and peripheral electronics such as mice, keyboards, and printers. (Return hard drives to University staff).
- 56 FLAT SCREEN TELEVISIONS AND MONITORS: Stand-alone flat screen display systems for television or computer use. Includes plasma and LCD monitors.
- 57 CRT TELEVISIONS AND MONITORS: Cathode Ray Tube (CRT) type televisions or monitors (not flat screen type).
- 58 TEXTILES: Includes clothing, fabrics, curtains, blankets, stuffed animals, and other cloth material. Does not include carpeting. Includes hospital-related textiles sorted from hospital-generated samples.
- 59 HOSPITAL TEXTILES: Includes white single sheets, white woven cotton blankets, white cotton pillow cases, and pillows. These items should only be searched for in the loads from the hospitals (Dock 2, Dock 1/Linen Dock/Auger, Good Samaritan).
- 60 RUBBER PRODUCTS: Finished products and scrap materials made of natural and synthetic rubber, such as bathmats, inner tubes (not tires), rubber hoses, and foam rubber. Includes rubber gloves and footwear (if predominately rubber).

2018 University of Kentucky Waste Characterization Study
Material Definitions

- 61 DISPOSABLE DIAPERS & SANITARY PRODUCTS: Adult and baby disposable diapers, and feminine hygiene products.
- 62 BOTTOM FINES & DIRT: Small mixed fragments 2" and smaller, and includes miscellaneous fines (paper, plastic, glass, etc.), sand, and dirt.
- 63 OTHER BULKY ITEMS: Large, hard-to-handle items that are not defined separately.
- 64 OLD FURNITURE: Examples include all sizes and types of furniture, mattresses, box springs, and base components.
- 65 TIRES: Any rubber tire intended to be used on a motorized vehicle or bicycle.
- 66 OTHER MISCELLANEOUS : Any other type of waste material not listed in any other sort category. Includes cosmetics, shampoos, lotions, etc.

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APPENDIX B
DETAILED STATISTICAL RESULTS BY GENERATOR
SECTOR

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Appendix B - Detailed Results by Generator Sector

Material Category	Front Loader Truck			General Campus			Dorms			Dining		
	Mean	Conf. Int	Tons	Mean	Conf. Int	Tons	Mean	Conf. Int	Tons	Mean	Conf. Int (+/-)	Tons
	Percent	(+/-)		Percent	(+/-)		Percent	(+/-)		Percent		
Paper	35.7%	3.2%	1,075	28.5%	11.5%	124	38.8%	13.4%	139	38.7%	5.0%	257
Corrugated Cardboard/Kraft Paper (Uncoated)	7.6%	2.9%	230	5.0%	3.1%	22	14.7%	9.5%	53	6.4%	3.2%	43
Office Paper (High Grade)	1.0%	0.8%	31	0.2%	0.2%	1	0.1%	0.2%	0	0.2%	0.1%	1
Mixed Recyclable Paper (Low Grade, ONP)	4.2%	1.5%	126	2.0%	0.6%	9	1.8%	1.6%	6	3.2%	0.6%	21
Magazines, catalogs, soft bound books	0.5%	0.4%	15	1.4%	1.8%	6	0.0%	0.0%	0	0.1%	0.1%	1
Hardbound Books	0.0%	0.0%	0	0.8%	1.1%	3	0.0%	0.0%	0	0.0%	0.0%	0
Aseptic Boxes & Gable Top Cartons	0.1%	0.1%	4	0.0%	0.0%	0	0.1%	0.1%	0	0.3%	0.1%	2
Compostable Paper	21.2%	2.1%	640	18.0%	8.6%	78	21.5%	9.0%	77	27.8%	3.8%	184
Remainder/Composite Paper	1.0%	0.4%	29	1.1%	1.0%	5	0.6%	0.6%	2	0.7%	0.1%	4
Plastic	23.1%	1.8%	698	20.0%	3.8%	87	21.8%	3.2%	78	27.6%	3.0%	183
Plastics # 1 PET Bottles Only	3.5%	0.7%	106	2.4%	1.8%	10	0.7%	0.3%	3	5.7%	1.8%	38
Plastics #1 PET Non-bottle Containers	0.4%	0.2%	11	0.4%	0.2%	2	0.4%	0.4%	1	0.5%	0.3%	3
Plastic # 2 (HDPE - Clear, colored bottles and jugs only)	0.6%	0.1%	17	0.3%	0.2%	1	1.8%	0.7%	6	0.5%	0.2%	4
Plastic Containers #3 thru #7	2.5%	0.3%	75	2.1%	0.9%	9	3.1%	1.1%	11	4.2%	0.8%	28
#4 Plastic Bottles	0.0%	0.0%	0	0.2%	0.4%	1	0.0%	0.0%	0	0.0%	0.0%	0
#5 Pipette holders and lids	0.1%	0.1%	2	0.2%	0.3%	1	0.0%	0.0%	0	0.0%	0.0%	0
#5 Hospital pitchers, basins, saline bottles	0.1%	0.1%	4	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0
#5 Christmas tree adaptors	0.1%	0.2%	4	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0
Plastic Film & Bags - Clean	0.3%	0.5%	10	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0
Plastic Film & Bags - Other	11.7%	1.3%	351	8.5%	3.3%	37	12.5%	3.3%	45	12.9%	0.7%	85
Data Storage Film	0.1%	0.1%	2	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0
Expanded Polystyrene Styrofoam™	1.1%	0.4%	33	0.8%	0.7%	3	0.0%	0.0%	0	1.3%	0.5%	9
Polystyrene (Styrofoam) lab transport containers	0.0%	0.0%	0	0.3%	0.4%	1	0.0%	0.0%	0	0.0%	0.0%	0
Remainder/Composite Plastic	2.7%	0.8%	81	4.7%	1.7%	21	3.2%	3.9%	12	2.4%	0.4%	16
Metal	4.2%	1.2%	127	1.5%	0.6%	6	3.6%	3.7%	13	3.3%	0.5%	22
Aluminum Cans	0.8%	0.3%	26	0.4%	0.3%	2	0.1%	0.1%	1	0.8%	0.4%	5
Aluminum Containers, Plates and foils	0.6%	0.3%	19	0.2%	0.2%	1	0.8%	0.9%	3	1.0%	0.6%	6
Steel Cans & Containers	0.2%	0.1%	6	0.2%	0.2%	1	0.8%	1.3%	3	0.6%	0.4%	4
Other Ferrous (magnetic)	1.2%	0.7%	35	0.0%	0.0%	0	1.4%	2.3%	5	0.0%	0.0%	0
Other Non-Ferrous (not magnetic)	0.6%	0.6%	17	0.3%	0.2%	1	0.0%	0.0%	0	0.1%	0.1%	0
Remainder/Composite Metal	0.8%	0.5%	24	0.4%	0.5%	2	0.4%	0.6%	1	0.8%	0.7%	5
Refrigerators/Freezers	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0
Glass	2.7%	1.4%	82	1.6%	0.9%	7	0.2%	0.1%	1	3.6%	1.0%	24
Glass Bottles and Jars (clear or colored)	2.7%	1.4%	82	1.4%	1.0%	6	0.2%	0.2%	1	3.3%	1.1%	22
Glass Containers - Non-Beverage	0.0%	0.0%	1	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0
Glass Lab Containers	0.0%	0.0%	0	0.1%	0.1%	0	0.0%	0.0%	0	0.1%	0.0%	0
Remainder/Composite Glass	0.0%	0.0%	0	0.1%	0.1%	0	0.0%	0.0%	0	0.3%	0.6%	2
Organics	18.0%	3.6%	544	21.2%	4.6%	92	33.2%	8.8%	119	20.6%	6.7%	136
Food Waste	13.0%	2.6%	391	13.7%	6.9%	60	31.4%	8.5%	113	20.3%	6.7%	135
Yard Waste Grass, Leaves & Brush	3.8%	3.3%	115	0.6%	0.8%	3	0.0%	0.0%	0	0.1%	0.0%	0
Miscellaneous Organics	1.2%	0.9%	37	6.8%	6.4%	30	1.6%	2.4%	6	0.2%	0.1%	1
Pallets	0.0%	0.0%	0	0.0%	0.0%	0	0.3%	0.4%	1	0.0%	0.0%	0
C&D	4.0%	2.3%	121	2.9%	3.2%	13	0.0%	0.0%	0	0.1%	0.0%	0
Wood - Treated	1.4%	1.7%	43	1.3%	2.2%	6	0.0%	0.0%	0	0.0%	0.0%	0
Wood - Untreated	0.7%	0.9%	22	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0
Asphalt	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0
Asphalt Roofing	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0
Brick, Concrete, and Rock	0.0%	0.0%	0	1.0%	1.2%	4	0.0%	0.0%	0	0.0%	0.0%	0
Carpet & Carpet Padding	0.8%	1.0%	25	0.1%	0.1%	0	0.0%	0.0%	0	0.0%	0.0%	0
Drywall/Gypsum Board	0.0%	0.0%	0	0.5%	0.8%	2	0.0%	0.0%	0	0.1%	0.1%	0
Remainder/Composite Construction & Demolition	1.0%	0.9%	31	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0
HHW	0.7%	0.8%	22	3.7%	5.2%	16	0.6%	0.9%	2	0.2%	0.2%	2
Household Hazardous Waste	0.2%	0.3%	7	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0
Aerosol cans	0.0%	0.1%	1	0.0%	0.1%	0	0.6%	0.8%	2	0.1%	0.1%	1
Treated Medical Waste	0.3%	0.6%	10	3.6%	4.5%	16	0.0%	0.0%	0	0.0%	0.0%	0
Batteries	0.1%	0.1%	3	0.0%	0.0%	0	0.0%	0.0%	0	0.1%	0.1%	1
Ballasts	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0
Lightbulbs	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0
Paint	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0
Electronics	0.9%	1.4%	28	0.3%	0.5%	1	0.0%	0.0%	0	0.1%	0.1%	0
Small Consumer Electronics	0.2%	0.2%	5	0.3%	0.4%	1	0.0%	0.0%	0	0.1%	0.1%	0
Computers and Related Electronics	0.1%	0.1%	3	0.1%	0.1%	0	0.0%	0.0%	0	0.0%	0.0%	0
Flat screen Televisions and Monitors	0.7%	1.1%	20	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0
CRT Televisions and Monitors	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0
Other	10.5%	2.2%	318	20.4%	12.0%	89	1.7%	1.5%	6	5.8%	3.3%	39
Medical Waste & Sharps	4.3%	1.9%	130	9.6%	10.0%	42	0.0%	0.0%	0	0.0%	0.0%	0
Textiles	1.2%	1.0%	37	2.1%	2.9%	9	0.3%	0.3%	1	1.2%	0.9%	8
Hospital Textiles	0.0%	0.1%	1	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0
Rubber Products	1.6%	0.8%	49	1.2%	1.0%	5	0.1%	0.1%	0	0.1%	0.2%	1
Disposable Diapers & Sanitary Products	0.6%	0.3%	17	0.2%	0.1%	1	0.0%	0.0%	0	0.8%	0.4%	5
Bottom Fines & Dirt	2.2%	0.5%	66	1.4%	0.9%	6	0.4%	0.6%	1	2.0%	0.4%	13
Other Bulky Items	0.3%	0.3%	8	2.2%	2.5%	10	0.5%	0.8%	2	1.2%	2.0%	8
Old Furniture	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0
Tires	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0	0.0%	0.0%	0
Other Miscellaneous	0.4%	0.4%	11	3.6%	2.5%	16	0.4%	0.5%	2	0.5%	0.3%	3
Total	100.0%		3,014	100.0%		434	100.0%		359	100.0%		663
Number of Samples	15			5			5			4		

Appendix B - Detailed Results by Generator :

Material Category	Football Stadium			Hospital			Bulky Dump Truck
	Mean	Conf. Int	Tons	Mean	Conf. Int	Tons	Mean
	Percent	(+/-)		Percent	(+/-)		Percent
Paper	28.6%	8.1%	43	15.8%	1.4%	1,379	39.6%
Corrugated Cardboard/Kraft Paper (Uncoated)	12.5%	11.8%	19	3.4%	1.4%	294	0.4%
Office Paper (High Grade)	0.0%	0.1%	0	0.1%	0.1%	11	0.7%
Mixed Recyclable Paper (Low Grade, ONP)	1.5%	1.1%	2	3.1%	0.3%	272	1.4%
Magazines, catalogs, soft bound books	0.0%	0.1%	0	0.3%	0.3%	23	8.4%
Hardbound Books	0.0%	0.0%	0	0.0%	0.0%	0	0.0%
Aseptic Boxes & Gable Top Cartons	0.0%	0.0%	0	0.2%	0.1%	20	0.0%
Compostable Paper	13.9%	2.5%	21	7.8%	1.5%	685	20.4%
Remainder/Composite Paper	0.6%	0.8%	1	0.9%	0.3%	75	8.3%
Plastic	22.4%	6.1%	34	22.0%	2.0%	1,918	10.8%
Plastics # 1 PET Bottles Only	5.0%	2.9%	7	1.3%	0.3%	116	1.0%
Plastics #1 PET Non-bottle Containers	0.2%	0.2%	0	0.3%	0.1%	25	0.1%
Plastic # 2 (HDPE - Clear, colored bottles and jugs only)	0.4%	0.3%	1	0.8%	0.4%	74	0.3%
Plastic Containers #3 thru #7	3.6%	1.9%	5	1.6%	0.4%	139	0.8%
#4 Plastic Bottles	0.0%	0.0%	0	0.0%	0.0%	0	0.0%
#5 Pipette holders and lids	0.0%	0.0%	0	0.1%	0.1%	7	0.0%
#5 Hospital pitchers, basins, saline bottles	0.0%	0.0%	0	3.8%	0.8%	336	0.0%
#5 Christmas tree adaptors	0.0%	0.0%	0	0.0%	0.0%	0	0.0%
Plastic Film & Bags - Clean	0.0%	0.0%	0	0.0%	0.0%	1	0.0%
Plastic Film & Bags - Other	11.4%	1.5%	17	11.2%	1.4%	977	8.0%
Data Storage Film	0.0%	0.0%	0	0.0%	0.0%	2	0.0%
Expanded Polystyrene Styrofoam™	0.5%	0.6%	1	1.0%	0.3%	89	0.4%
Polystyrene (Styrofoam) lab transport containers	0.0%	0.0%	0	0.0%	0.0%	1	0.0%
Remainder/Composite Plastic	1.3%	0.7%	2	1.7%	0.3%	152	0.2%
Metal	3.4%	1.8%	5	2.4%	1.1%	213	13.1%
Aluminum Cans	2.1%	0.9%	3	0.5%	0.2%	43	0.3%
Aluminum Containers, Plates and foils	1.0%	0.4%	2	0.1%	0.0%	5	0.3%
Steel Cans & Containers	0.0%	0.0%	0	0.7%	1.0%	59	0.0%
Other Ferrous (magnetic)	0.3%	0.4%	0	0.6%	0.7%	52	12.5%
Other Non-Ferrous (not magnetic)	0.0%	0.0%	0	0.1%	0.0%	5	0.0%
Remainder/Composite Metal	0.0%	0.0%	0	0.3%	0.3%	23	0.0%
Refrigerators/Freezers	0.0%	0.0%	0	0.3%	0.5%	25	0.0%
Glass	7.6%	4.5%	12	0.6%	0.2%	50	1.1%
Glass Bottles and Jars (clear or colored)	7.6%	4.5%	12	0.6%	0.3%	50	1.1%
Glass Containers - Non-Beverage	0.0%	0.0%	0	0.0%	0.0%	0	0.0%
Glass Lab Containers	0.0%	0.0%	0	0.0%	0.0%	0	0.0%
Remainder/Composite Glass	0.0%	0.0%	0	0.0%	0.0%	0	0.0%
Organics	34.9%	5.3%	53	9.3%	4.5%	810	8.5%
Food Waste	34.9%	5.4%	53	9.2%	4.5%	807	7.9%
Yard Waste Grass, Leaves & Brush	0.0%	0.0%	0	0.0%	0.0%	0	0.0%
Miscellaneous Organics	0.0%	0.1%	0	0.0%	0.0%	3	0.7%
Pallets	0.0%	0.0%	0	0.0%	0.0%	0	0.0%
C&D	0.0%	0.0%	0	3.0%	5.2%	264	18.3%
Wood - Treated	0.0%	0.0%	0	0.1%	0.2%	9	0.0%
Wood - Untreated	0.0%	0.0%	0	0.0%	0.0%	0	0.6%
Asphalt	0.0%	0.0%	0	0.0%	0.0%	0	0.0%
Asphalt Roofing	0.0%	0.0%	0	0.0%	0.0%	0	0.0%
Brick, Concrete, and Rock	0.0%	0.0%	0	0.0%	0.0%	2	0.0%
Carpet & Carpet Padding	0.0%	0.0%	0	0.0%	0.0%	0	0.0%
Drywall/Gypsum Board	0.0%	0.0%	0	0.3%	0.4%	22	0.0%
Remainder/Composite Construction & Demolition	0.0%	0.0%	0	2.6%	3.8%	230	17.7%
HHW	0.0%	0.0%	0	0.5%	0.8%	43	5.3%
Household Hazardous Waste	0.0%	0.0%	0	0.0%	0.0%	0	0.1%
Aerosol cans	0.0%	0.0%	0	0.0%	0.0%	4	0.3%
Treated Medical Waste	0.0%	0.0%	0	0.4%	0.7%	38	0.0%
Batteries	0.0%	0.0%	0	0.0%	0.0%	2	0.0%
Ballasts	0.0%	0.0%	0	0.0%	0.0%	0	0.0%
Lightbulbs	0.0%	0.0%	0	0.0%	0.0%	0	0.0%
Paint	0.0%	0.0%	0	0.0%	0.0%	0	4.9%
Electronics	0.0%	0.0%	0	0.1%	0.0%	8	0.2%
Small Consumer Electronics	0.0%	0.0%	0	0.1%	0.1%	8	0.0%
Computers and Related Electronics	0.0%	0.0%	0	0.0%	0.0%	0	0.2%
Flat screen Televisions and Monitors	0.0%	0.0%	0	0.0%	0.0%	0	0.0%
CRT Televisions and Monitors	0.0%	0.0%	0	0.0%	0.0%	0	0.0%
Other	3.1%	0.8%	5	46.3%	6.3%	4,043	3.1%
Medical Waste & Sharps	0.0%	0.0%	0	29.6%	5.6%	2,586	0.0%
Textiles	1.5%	0.9%	2	2.9%	0.9%	255	0.1%
Hospital Textiles	0.0%	0.0%	0	1.2%	0.7%	101	0.0%
Rubber Products	0.1%	0.1%	0	3.9%	0.8%	337	0.0%
Disposable Diapers & Sanitary Products	0.3%	0.2%	0	6.8%	3.6%	591	0.0%
Bottom Fines & Dirt	0.9%	0.7%	1	0.9%	0.2%	81	0.7%
Other Bulky Items	0.1%	0.1%	0	0.1%	0.1%	6	2.1%
Old Furniture	0.0%	0.0%	0	0.0%	0.0%	0	0.0%
Tires	0.0%	0.0%	0	0.0%	0.0%	0	0.0%
Other Miscellaneous	0.2%	0.3%	0	1.0%	0.5%	84	0.3%
Total	100.0%		151	100.0%		8,728	100.0%
Number of Samples	4			10			1

APPENDIX C

DETAILED CAPTURE RATE RESULTS

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Appendix C - Detailed Capture Rate Results

Disposal Category	Disposed (tons)	Recycled (tons)	Generated (tons)	Capture Rate
Single Stream Recyclable	1,899	1,804	3,703	48.7%
Corrugated Cardboard/Kraft Paper	660		660	
Office Paper (High Grade)	44		44	
Mixed Recyclable Paper	437		437	
Magazines, catalogs, soft bound books	49		49	
Plastics # 1 PET Bottles Only	280		280	
Plastic # 2 (HDPE bottles & jugs)	103		103	
Aluminum Cans	79		79	
Steel Cans & Containers	73		73	
Glass Bottles and Jars (clear or colored)	173		173	
Glass Containers - Non-Beverage	1		1	
Other Recyclable	363	122	485	25.1%
Hardbound Books	3	52	55	93.9%
Data Storage Film	4	5	9	51.3%
Tires	0	6	6	100.0%
Cooking Oil	0	31	31	100.0%
Mixed Media	0	8	8	100.0%
Toner/Cartridges	0	5	5	100.0%
Motor Oil	0	6	6	100.0%
#4, #5 Plastics and Blue Wrap	355	10	365	2.6%
#4 Plastic Bottles	1			
#5 Pipette holders and lids	10			
#5 Hospital pitchers/basins/bottles	340			
#5 Christmas tree adaptors	4			
Recyclable Metal	240	305	545	56.0%
Aluminum Containers, Plates and foils	36			
Other Ferrous (magnetic)	99			
Other Non-Ferrous (not magnetic)	23			
Remainder/Composite Metal	55			
Refrigerators/Freezers	25			
Electronics	38	180	218	82.7%
Small Consumer Electronics	14			
Computers & Related Electronics	4			
Flat Screen TVs & Monitors	20			
CRT TVs and Monitors	0			
Green Waste				
Yard Waste Grass/Leaves/Brush	118	60	178	33.5%
Pallets/Logs/Chips	1	213	214	99.4%
Pallets	1			
Food Waste				
Food Waste	1,561	1	1,562	0.1%
Batteries/Lamps	5	12	17	69.1%
Batteries	5	9	14	61.7%
Ballasts	0			
Lightbulbs	0	3	3	100.0%
Disposed	9,170	0	9,170	0.0%
Aseptic Boxes & Gable Top Cartons	26			
Compostable Paper	1,696			
Remainder/Composite Paper	120			
Plastics #1 PET Non-bottle Containers	42			
Plastic Containers #3 thru #7	268			
Plastic Film & Bags - Clean	12			
Plastic Film & Bags - Other	1,516			
Expanded Polystyrene Styrofoam™	135			
Polystyrene (Styrofoam) lab containers	3			

Appendix C - Detailed Capture Rate Results

Material Category	Disposed (tons)	Recycled (tons)	Generated (tons)	Capture Rate
Remainder/Composite Plastic	284			
Glass Lab Containers	0			
Remainder/Composite Glass	3			
Miscellaneous Organics	78			
Wood - Treated	58			
Wood - Untreated	23			
Asphalt	0			
Asphalt Roofing	0			
Brick, Concrete, and Rock	6			
Carpet & Carpet Padding	25			
Drywall/Gypsum Board	25			
Remainder/Composite C&D	269			
Household Hazardous Waste	7			
Aerosol cans	8			
Treated Medical Waste	64			
Paint	2			
Mixed Medical Facility Waste	2,758			
Hospital Textiles	102			
Textiles	312			
Rubber Products	393			
Diapers/Sanitary Products	615			
Bottom Fines & Dirt	170			
Other Bulky Items	35			
Old Furniture	0			
Other Miscellaneous	115			
Total	13,395	2,696	16,092	16.8%





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